CHAPTER 21-5 ELECTRICAL GUIDELINES

21-5.1 INTRODUCTION

A. PURPOSE - The purpose of this chapter is twofold:

(1) To convey to the architect/engineer (A/E), Indian Service (IHS) staff, and tribal staff both general and specific guidelines regarding electrical design features required for IHS health care facilities including tribal health care facilities.

(2) To inform the A/E, IHS, and tribal staff of the requirements for each submittal of the construction documents for approval.

B. SCOPE - The scope of this chapter includes all special-purpose type construction or renovation required by IHS health care facilities including quarters.

C. CODES and STANDARDS - Design shall comply with:

(1) Codes and Standards required in this Chapter;

(2) Local codes and ordinances (if this represents a major cost increases, advise the IHS contracting officer);

(3) Rules and regulations of the local utility companies;

(4) National Fire Protection Association (NFPA) Codes and Standards, including the National Electrical Code (NEC), NFPA 72, 75, 99, and 101;

(5) Illuminating Engineering Society (IES) Lighting Handbook; and

(6) Other applicable standards such as National Electrical Manufacturers Association (NEMA), Underwriters Laboratories Inc. (UL), and American National Standards Institute (ANSI) including National Electrical Safety Code (NESC)

21-5.2 ALTERNATE POWER FOR HEALTH CARE FACILITIES

21-5.2.1 INTRODUCTION

A. PURPOSE - This chapter provides guidance for determining alternate power (AP) requirements for Indian Health Service (IHS) and Tribal Facilities. The IHS provides alternate power for health care facilities when required by the National Fire Protection Association (NFPA) and special site conditions. These instructions are in conformance with the latest edition of the American Institute of Architects (AIA) Guidelines for Construction and Equipment of Hospital and Medical Facilities.

B. SCOPE - In paragraph 21-5.1.2 of this Section, alternate power requirements details the specific application of this policy to IHS typical projects. IHS Design Criteria Committee dated November 6, 1989, has emphasized NFPA standards by restating that "emergency generator loads should be as specified in NFPA 99 (Chapter 3, Electrical Systems; Chapter 12, Hospital Requirements; Chapter 13, Ambulatory Health Care Center Requirements).... Any major generator upgrade will require IHS Headquarters approval with Engineering Services (ES) recommendation." AP system post disaster mission requirements are not addressed in this facility criteria.

C. REFERENCE STANDARDS - The following reference standards are used as the basis of this Section:

(1) AIA Guidelines for Construction and Equipment of Hospital and Medical Facilities

Note: The American National Standard Institute (ANSI) and NFPA standards referenced in the AIA standard are listed below:

- ANSI/NFPA 70 National Electrical Code
- ANSI/NFPA 99 Standard for Health Care Facilities
- NFPA 101 Life Safety Code
- NFPA 110 Standard for Emergency and Standby Power Systems

D. DEFINITIONS

(1) ALTERNATE POWER SOURCE - In reference to NFPA 70 and 99, an alternate power source is, one or more generator sets or battery systems, where permitted, intended to provide power during the interruption of the normal electrical service or the public utility electrical service intended to provide power during interruption of service normally provided by the generating facilities on the premises.

(2) LIFE CYCLE COST (LCC) - The LCC is the sum of all costs over the useful life of a building, system or product. It includes the costs of design, construction, acquisition, operation and maintenance, and the salvage value, if any, using present worth (PW) costs. A discussion of LCC applications is provided in the Department of Energy NBS Handbook 135, Life-Cycle Costing Manual by Rosalie T. Ruegg.

(3) SPECIFIC OCCUPANCIES - These specific occupancies are defined in NFPA 99 and/or NFPA 101. The occupancies discussed in this Chapter include the following: Hospital, Ambulatory Health Care Center, Health Station, Nursing Home, Support Facility, Multi-family/Single-family Residence, and Youth Treatment Center.

E. TECHNICAL SUPPORT - IHS staff available to discuss the technical requirements for Alternate Power for Health Facilities are:

IHS Headquarters - Director, Division of Facilities Planning and Construction

Area Office - Director, Facility Management

The Engineering Services staff are available for technical assistance:

ES-Dallas - Electrical Engineer Staff

ES-Seattle - Electrical Engineer Staff

21-5.2.2 FACILITY ALTERNATE POWER REQUIREMENTS

The listed AP requirements are only intended to meet the previously listed reference codes and standards as they relate to the operation of IHS facilities. AP equipment and distribution should be limited to only essential loads so as to improve reliability, and reduce system operation and maintenance costs. The essential AP equipment is not intended to ensure full function of a facility during a power outage, but is intended to meet certain present emergency codes and standards. Minimum AP distribution requirements defined in listed references are listed below as "Basic". Other AP distributions permitted, but not required, are listed below as "Additional". On a case by case basis, as justified due to proven history of unreliable utility power, standby power may be authorized in the Program of Requirements (POR) to allow the facility to function or near fully function during extended power outages, if critical care areas are present in a facility.

A. HOSPITAL

NFPA 99/101 Listing - Hospital

(1) Basic: Hospital must have AP providing Type I Essential Electrical System service to functions requiring AP per NFPA 99.

In addition, the AIA Guidelines for Construction and Equipment of Hospital and Medical Facilities requires the following:

(a) Where stored fuel is required for emergency electrical source, storage capacity shall permit continuous operation for at least 24 hours; and

(b) As a minimum, each patient bed and treatment space shall have access to a receptacle on the critical branch of the emergency power system.

(2) Additional: AP consideration may be provided for the following:

(a) automatic lab bio-analyzers,
(b) data processing equipment rooms which are designed to meet NEC Art. 645, and
(c) selected oral surgery operatory lights, receptacles, and equipment.

NOTE: Dental Scavenger Gas Exhaust will not be on AP. The presence or absence of AP shall not effect the decision to use nitrous oxide for dental analgesia.

B. AMBULATORY HEALTH CARE CENTER

NFPA 99/101 Listing - Ambulatory Health Care Center

(1) Basic: Ambulatory Health Care Center must have AP providing Type III Essential Electrical System service to functions that requires AP per NFPA 99 (battery powered). Type I Essential Electrical System service may be required if critical care areas are present in this facility.

(2) Additional: When Type I Essential Electrical System is required AP may be considered to support the following:

(a) automatic lab bio-analyzers;
(b) data processing equipment rooms which are designed to meet NEC Article 645; and
(c) selected oral surgery operatory lights, receptacles, and equipment.

NOTE: Dental Scavenger Gas Exhaust will not be on AP.

C. HEALTH STATION

NFPA 99 Listing - Clinic

(1) Basic: Health Clinics will be equipped with AP providing Type III Essential Electrical System service to functions that require AP, per NFPA 99 (battery powered)

(2) Additional: None

D. INTERMEDIATE/SKILLED NURSING FACILITY

NFPA 99 Listing - Nursing Home

(1) Basic: Nursing Homes will be equipped with AP providing Type II Essential Electrical System service to functions that require AP, per NFPA 99.

(2) Additional: None

E. SUPPORT FACILITY

NFPA 101 Listing - Business Occupancy

(1) Basic: No AP is required to Support Facilities.

(2) Additional: None

F. STAFF RESIDENTIAL BUILDING

NFPA 101 Listing - Multi-family/Single-family Residence

(1) Basic: No AP is required for Staff Residential Buildings.

(2) Additional: None

G. YOUTH TREATMENT CENTER

NFPA 101 Listing - Residential Board and Care Occupancy

(1) Basic: Youth Treatment Center will be equipped with AP (battery powered) emergency service, per NFPA 101-22.

(2) Additional: None

21-5.3 STANDBY POWER SYSTEM GENERATOR SELECTION CRITERIA

21-5.3.1 PURPOSE

This chapter provides guidelines for determining when optional, non-code mandated standby power system generators are recommended for Indian Health Service (IHS) and tribal facilities. The emergency generators required for health facilities by the National Fire Protection Association (NFPA), American Institute of Architects (AIA), and IHS are discussed in the Technical Handbook for Environmental Health and Engineering, Volume III, Part 21, Chapter 21-5 “Electrical Guidelines.”

21-5.3.2 SCOPE

IHS and tribal facilities that do not have a demonstrated need for alternate power (emergency generators) per NFPA, IHS, and AIA guidelines as noted above, may still be considered for a standby power system generator(s). Evaluation criteria in this chapter may be used to determine whether standby power is required, and if so, whether it should consist of an installed generator, or only wiring and connections for placing and using a portable generator. The selection form included with this chapter provides a Standby System Risk Calculation (SSRC), which considers facility "risk" and provides a standby system recommendation. The SSRC satisfies the economic and human safety justification requirements for standby power system generators at IHS facilities.

21-5.3.3 REFERENCE STANDARDS

Latest edition of the AIA Guidelines for Construction and Equipment of Hospital and Medical Facilities.

Note: The American National Standard Institute (ANSI) and the National Fire Protection Association (NFPA) requirements referenced in the AIA standard are listed below:

ANSI/NFPA 70	National Electrical Code
ANSI/NFPA 99	Standard for Health Care Facilities
NFPA 101	Life Safety Code
NFPA 110	Standard for Emergency and Standby Power Systems
ANSI/IEEE	Standard 446 - IEEE Recommended Practice for Emergency and Standby Power for Industrial and Commercial Applications.

21-5.3.4 DEFINITIONS

A. ALTERNATE POWER SOURCE - An alternate power source is, one or more generator sets or battery systems, where permitted, intended to provide power during the interruption of normal electrical service or the public utility electrical service intended to provide power during interruption of service normally provided by generating facilities on the premises.

B. EMERGENCY POWER SYSTEM - An independent reserve source of electric energy that, upon failure or outage of the normal source, automatically provides reliable electric power within a specified time to critical devices and equipment whose failures to operate satisfactorily would jeopardize the health and safety of personnel, or result in damage to property.

C. STANDBY POWER SYSTEM - An independent reserve source of electric energy that, upon failure or outage of the normal source, provides electrical power of acceptable quality so that the user's facilities may continue in satisfactory operation.

21-5.3.5 PROGRAM OF REQUIREMENTS

A facility's Program of Requirements will state whether standby generators are needed. The need for standby system generator(s) will be determined by the Area Facility Engineer.

21-5.3.6 RISK CALCULATI0N FACTORS/SELECTION CRITERIA

A. Risk Calculation Factors

A common criteria used to determine the need for specific facility equipment or systems is the risk factor evaluation. Such evaluations provide specific recommendations for such equipment as facility seismic and lightning arrester systems.

The selection criteria discussed below is the Standby System Risk Calculation. This calculation will help determine whether:

(1) to provide facility standby generator(s),

(2) to provide portable generator connections only, or

(3) that standby power is not justified.

A "risk value" calculation greater than eight will demonstrate the need for an on-site standby system generator for facilities where there is no strict code requirement for Alternate Power (AP) using generator(s).

STANDBY SYSTEM RISK CALCULATION (SSRC)

SSRC VALUE = (A+B+C+D+E+F)/(G)

SSRC VALUE	**ON-SITE GENERATOR**
Greater than 8	STANDBY SYSTEM GENERATOR SUPPORTED
5-8	PORTABLE STANDBY GENERATORCONNECTION ONLY
Less than 5	STANDBY SYSTEM GENERATOR NOT JUSTIFIED

A = TYPE OCCUPANCY	**INDEX**
1 - Hospital	10
2 - Ambulatory Health Care Center	8
3 - Intermediate or Skilled Nursing Facility	6
4 - Alcohol/Substance Abuse Program Facility (ASAP)	5
5 - Health Clinic or Station	4
6 - Staff Residential Building	2
7 - Support or Other Facility	1

B = UTILITY VARIANCE HISTORY (See local utility for information)		**INDEX**
Greater than 10	Voltage variation	10
9% -10%	Voltage variation	7
7% - 8%	Voltage variation	5

5% - 6% Voltage variation 1

0% - 4% Voltage variation 0

C = PERSONS RESIDENT (OVERNIGHT) IN FACILITY INDEX

16 or greater 10
1 to 15 4

None 0

D = FULL TIME ON SITE MAINTENANCE STAFF INDEX

Yes 3

No 0

E = UTILITY FEEDER TYPE INDEX
(See local utility for information)

Single Radial Line Feed 10

Dual Line Feed 5

Grid Line Feed 1

F = POST DISASTER MISSION (See Prog. of Requirements) INDEX

Yes 10

No 0

G = UTILITY POWER OUTAGE HISTORY INDEX
(ANNUAL 15 MINUTE OUTAGES/See local utility for information)

None or 1 5

2 to 3 4

4 to 5 3

6 to 12 2

13 or Greater 1

B. STANDBY SYSTEM SELECTION CRITERIA FORM

Use the Risk Calculation Factors discussed in Section A, above, to determine specific project standby system generator requirements, by using the "Standby System Generator Selection Form."

STANDBY SYSTEM GENERATOR SELECTION FORM

FACILITY: ______________________________ LOCATION:________________

Evaluator:______________________________ Date: ________________
(Area Facility Manager)

YES:______, Standby System Generator Supported

YES:______, Portable Standby System Generator Connections Only

NO :______, Standby System Generator Is Not Justified

STANDBY SYSTEM RISK CALCULATION (SSRC)									**INDEX SCORE**
A: TYPE OF OCCUPANCY (See page 3-Occupancy)	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
Index	**0**	**1**	**2**	**4**	**5**	**6**	**8**	**10**	______
B: UTILITY (Voltage) VARIANCE HISTORY*	**0-4%**	**5-6%**	**7-8%**	**9-10%**		**10+**			
Index	**-**	**0**	**1**	**5**	**7**		**10**		_____
C: PERSONS RESIDENT (OVERNIGHT) IN FACILITY		**None**		**1 to 15**		**16+**			
Index		**0**		**4**		**10**			_____
D: FULL TIME SITE MAINTENANCE STAFF		**No**		**Yes**					
Index		**0**		**3**					______
E: UTILITY FEEDER TYPE*		**Grid**		**Dual**		**Single**			
Index		**1**		**5**		**10**			______
F: POST DISASTER MISSION		**No**		**Yes**					
Index		**0**		**10**					_____

____

TOTAL (A to F) ______

G: UTILITY POWER OUTAGE HISTORY*	**0-1**	**2-3**	**4-5**	**6-12**	**13+**	
Index	**5**	**4**	**3**	**2 1**		_______

SSRC POINT VALUES	**Less than 5**	**5-8**	**8+**
$\frac{(A+B+C+D+E+F)}{G}$	**NO STANDBY GENERATOR SYSTEM**	**PORTABLE GENERAL CONNECTION**	**STANDBY SYSTEM GENERATOR**

ONLY

***See utility for information**

21-5.4 ELECTRICAL POWER QUALITY

21-5.4.1 PURPOSE

This chapter provides guidance for design and installation practices which will assure reliable facility electrical power quality for sensitive electronic equipment in Indian Health Service (IHS) and Tribal Facilities. Technologically advanced electronics and communications equipment and devices which is now routinely incorporated in facilities must be operationly dependable and cost effective. This guideline will assure a dependable and cost effective operation of this equipment.

21-5.4.2 SCOPE

The electrical power and grounding which will support the normal and safe operation of sensitive electronic equipment at IHS and Tribal Facilities is detailed in this document. Using the Institute of Electrical and Electronic Engineers (IEEE) Recommended Practice for Powering and Grounding Sensitive Electronic Equipment and several other national codes as references power quality criteria is provided for various types of existing and proposed facilities.

21-5.4.3 REFERENCE STANDARDS

The following reference standards are used as the basis of this document:

A. Institute of Electrical and Electronic Engineers (IEEE), IEEE Std. 1100-1992, IEEE Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.

B. American Institute of Architects (AIA) Guidelines for Construction and Equipment of Hospital and Medical Facilities.

C. American National Standard Institute (ANSI)

(1) ANSI C62.41 IEEE Recommendation for Surge Voltage in Low-Voltage AC Power Circuits.

(2) ANSI C62.45 IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

(3) ANSI C84.1 Electrical Power Systems and Equipment-Voltage Ratings (60 Hz)

D. National Fire Protection Association (NFPA)

(1) NFPA 70 National Electrical Code

(2) NFPA 99 Standard for Health Care Facilities

(3) NFPA 101 Life Safety Code

21-5.4.4 DEFINITIONS

A. Harmonic - A component frequency of a harmonic motion (as of an electromagnetic wave) that is an integral multiple of the fundamental frequency. For example, the 3rd harmonic is 60 Hz multiplied by 3, or 180 Hz. The introduction of distortion into the main 60 Hz current (or voltage) sine wave results in additional currents or voltages (harmonics) which are introduced into the electrical system at the multiples of the fundamental 60 Hz current (or voltage).

B. Noise - Electrical noise is unwanted electrical signals that produce undesirable effects in the circuits of the control systems in which they occur.

C. Power Quality - The concept of powering and grounding sensitive electronic equipment in a manner that is suitable to the operation of that equipment.

D. Shielding - Shielding is the use of a conducting barrier between a potentially disturbing noise source and sensitive circuitry. Shields are used to protect cables (data and power) and electronic circuits. They may be in the form of metal barriers, enclosures, or wrapping around source circuits and receiving circuits.

E. Total Harmonic Distortion (THD) - A condition that exists when one or more harmonic current or voltage waveforms are added to the fundamental (60 Hz) waveform, thereby altering its shape. This value is expressed as a percentage.

F. Transient Voltage Surge Suppression (TVSS) - The action of an solid state device which clamps the voltage of the distorted waveform to a safe level and then redirects the potentially enormous current associated with the surge away from sensitive electronic equipment. See ANSI/IEEE C62.41-1980 for location application categories. The UL Standard 1449 is the standard to assure TVSS product safety and uniform performance evaluation.

G. Voltage Distortion - Any deviation from the nominal sine waveform of the ac line voltage.

21-5.4.5 FACILITY ELECTRICAL POWER QUALITY REQUIREMENTS

A. Introduction - Successful practices which will assure reliable facility electrical power quality are a joint effort of the local power company and the facility designers. The power company normally provide service which will minimize waveform distortion and outages as a result of lightning, heavy rains, strong winds, ice build-up, heavy snow, and system load. The designer must verify existing service power quality and site facility conditions and practices in addition to the new project requirements which will allow for acceptable power quality. Example design considerations are site grounding, harmonic currents generated by adjustable speed drives/electronic ballasts and computers etc., distance from electrical panels to electronic loads, lightning activity, and alternate power supply switching transients (generator start-up) to mention a few concerns. An evaluation of utility service and facility power quality elements has resulted in the information detailed in the following paragraph for seven types of IHS/Tribal facilities.

B. Power Quality Requirements - Basic requirements are mandatory minimums. Additional requirements shall apply as warranted for the installation as a result of the designer verification of existing service/site facility conditions and the review of new project requirements.

(1) HOSPITAL

NFPA 99/101 Listing - Hospital

a. Basic: Install Transient Voltage Surge Suppression at the main electrical service, telephone, data, cctv, and mctv service connection panels.

Building service ground shall be 25 ohms or less as measured using the fall of potential method. Test results shall be posted adjacent to the main electrical service panel directory.

Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.

AC Distribution Systems - Four hundred eighty volts system 3 phase is recommended when economically feasible as opposed to 208 volts 3 phase. Connect electronic loads near the source not at a downstream panel. Don't use 120 volts for the distribution voltage.

b. Additional: Transient voltage surge suppression shall additionally be provided at electrical sub-panels and branch circuits when facility conditions indicate this need. Example potential application would provide surge protection on branch circuit with dedicated fluorescent lighting/electronic ballast load with localized surge activity.

Isolation transforms with shielded windings for disturbances on the power system conductors.

Noise filters when low energy, high frequency noise on conductors.

Harmonic filters to trap harmonic currents from being feed back to line.

Standby power system (battery-inverter type) operating as a UPS will provide power when utility power fails.

(2) AMBULATORY HEALTH CARE CENTER

NFPA 99/101 Listing - Ambulatory Health Care Center

a. Basic: Install Transient Voltage Surge Suppression at the main electrical service, telephone, data, cctv, and mctv service connection panels.

Building service ground shall be 25 ohms or less as measured using the fall of potential method. Test results shall be posted adjacent to the main electrical service panel directory.

Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.

b. Additional: Transient voltage surge suppression shall additionally be provided at electrical sub-panels and branch circuits when facility conditions indicate this need. Example potential application would provide surge protection on branch circuit with dedicated fluorescent lighting/electronic ballast load with localized surge activity.

Isolation transforms with shielded windings for disturbances on the power system conductors.

Noise filters when low energy , high frequency noise on conductors.

Harmonic filters to trap harmonic currents from being feed back to line.

Standby power system (battery-inverter type) operating as a UPS will provide power when utility power fails.

(3) HEALTH STATION

NFPA 99 Listing - Clinic

a. Basic: Install Transient Voltage Surge Suppression at the main electrical service, telephone, data, cctv, and mctv service connection panels.

Building service ground shall be 25 ohms or less as measured using the fall of potential method. Test results shall be posted adjacent to the main electrical service panel directory.

Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.

b. Additional: Transient voltage surge suppression shall additionally be provided at branch circuits when facility conditions indicate this need. Example potential application would provide surge protection on branch circuit with dedicated fluorescent lighting/electronic ballast load with localized surge activity.

(4) SUPPORT FACILITY

NFPA 101 Listing - Business Occupancy

a. Basic: Install Transient Voltage Surge Suppression at main service entrance panel.

Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.

b. Additional: Transient voltage surge suppression shall additionally be provided at branch circuits when facility conditions indicate this need. Example potential application would provide surge protection on branch circuit with dedicated fluorescent lighting/electronic ballast load with localized surge activity.

(5) STAFF RESIDENTIAL BUILDING

NFPA 101 Listing - Multi-family Residence

a. Basic: Install Transient Voltage Surge Suppression at main service entrance panel.

Electronic equipment specifications shall include a selection factor of low Total

Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.

b. Additional: Transient voltage surge suppression shall additionally be provided at branch circuits when facility conditions indicate this need. Example potential application would provide surge protection on branch circuit with dedicated fluorescent lighting/electronic ballast load with localized surge activity.

(6) YOUTH TREATMENT CENTER

NFPA 101 Listing - Residential Board and Care Occupancy

a. Basic: Install Transient Voltage Surge Suppression at main service entrance panel.

Electronic equipment specifications shall include a selection factor of low Total Harmonic Distortion (THD). Example: electronic ballast for fluorescent light fixtures shall have less than 20% THD.

b. Additional: Transient voltage surge suppression shall additionally be provided at branch circuits when facility conditions indicate this need. Example potential application would provide surge protection on branch circuit with dedicated fluorescent lighting/electronic ballast load with localized surge activity.

21-5.5 BUILDING AUTOMATION SYSTEMS

21-5.5.1 OVERVIEW

A. PURPOSE - This technical handbook chapter provides guidelines for selecting building automation systems in health care facilities.

B. SCOPE - Building automation systems (BAS) can be used to ensure proper environmental conditions within a facility. The Indian Health Service (IHS) will consider installation of building automation systems in all health facilities being constructed new or undergoing renovation. Where appropriate, IHS will plan projects to include BAS in health care facilities. Building automation systems may also offer cost effective features on small projects.

C. DEFINITIONS

Building Automation Systems (BAS) also referred to as a direct digital control system, is a system of devices and associated software that together allow for monitoring, controlling, and recording many conditions within a facility. The BAS generally links the devices to modern computer systems. The system can consist of stand alone devices that monitor only critical building elements, such as boilers and chillers, or special spaces, such as operating suite ventilation. Typically, however, a BAS incorporates many such building elements and environments into a larger system that is monitored, controlled, and recorded in a central location.

21-5.5.2 POLICY

A. GENERAL - There is considerable diversity in IHS facility types and locations. This, coupled with the large number of acceptable operational strategies, makes it impossible to absolutely define building automation system architecture or its implementation for each occupancy or building type. A more flexible and reasonable method is to consider general requirements that have led to successful installations. The following information is intended to assist Area Office Project Managers, Engineering Services (ES) Project Managers, and Service Unit representatives to understand and consider an appropriate building automation system for inclusion in project design.

B. BACKGROUND - The technological revolution in the computer field has directly affected building automation systems. The technology now allows for dependable direct digital control of a wide variety of equipment that has traditionally been controlled by pneumatic systems.

This new technology comes at a time when buildings need to become more efficiently operated and dependable. The appropriate use of building automation systems permits increased monitoring and control of specified environmental conditions, energy consumption, and equipment status and performance within the facility. It encourages increased equipment efficiency and reliability through the use of dynamic feedback and data comparison, which can be used to detect trends and/or changes from the original or normal readings. This information can even be analyzed at locations that are remote from the facility itself. These capabilities allow building automation systems to also offer significant improvements to the risk management and quality assurance activities of health care facilities.

C. APPLICATIONS - The users and designers must determine, early in the planning and development phases of projects, the building systems or environments that will be controlled or monitored by the BAS. The Area, ES, and the Service Units will each have a role in determining the degree to which each building system will be controlled or monitored. The designers must consider, during the selection of the BAS, that it meets the following: ease of operation, ability to be upgraded/expanded, location and ability of available support service centers, reasonable cost, reliability, associated training requirements, the facility’s long term needs, and an ability to interact with the various types of equipment or systems it controls or monitors. The design effort must ensure that the technical specifications clearly define the system’s salient features. It should also be compatible with a facilities maintenance management program.

The minimum requirements for installing a building automation system for a renovation or expansion project should match those mentioned above. In addition, the new system must be compatible with any existing control or monitoring system that is retained. The design and installation of a BAS on a renovation or expansion project in an existing facility is highly variable, and must be considered on a project specific basis. Items to be considered in the determination of the extent of the new system include the size of the project, the type and importance of the areas impacted by the project, the type and extent of any existing BAS, the availability of funds, the expertise of the staff maintaining the facility and the BAS, the past performance of the existing control system, and changing regulatory requirements.

The installation of building automation systems in new construction is highly desirable. A more comprehensive building automation system may be possible for a new facility, compared to a renovation project on an existing facility. It should be noted that a building automation system installed in a completely new facility will dictate that the building will not be ready for occupancy until the BAS is operational and the system operators are satisfactorily trained.

D. PRIORITY OF APPLICATION OF BUILDING AUTOMATION SYSTEMS - The type, number, and importance of systems and equipment for inpatient health facilities is usually of a higher magnitude than those found at outpatient facilities. From a risk management perspective, the effective use of available resources is to provide building automation systems at inpatient health care facilities first before outpatient facilities.

Most Indian Health Service outpatient facilities are located at remote sites and are not usually occupied 24 hours per day. Therefore, the need to assess the status of plant equipment during occupied and unoccupied hours at these facilities will often be justified. The declining cost of building automation systems allows an appropriate level of control and monitoring for both inpatient and outpatient facilities.

E. SUGGESTED SYSTEMS & FORMATS - Most problems with the operation of building automation systems are not caused by failure of the system, but rather from the user not understanding the system well enough to make it work for the staff. It is expected that a complex building automation system will require considerable resources in staff time as well as operating funds for operator training and development. Adequate training must be included so that staff operating the BAS fully comprehend the theory of operation of the systems being controlled, as well as the operational theory of the BAS itself. From this perspective, it is important that the designer carefully consider the staff’s ability to operate the selected building automation system. The designer should work with the staff responsible for maintaining the BAS to ensure that they understand the difference between the two main types of programming for building automation systems: line-by-line programming, or graphic interfacing. Designers of successful systems ensure that the owner has a vested interest in the type of system selected and its operation.

The following systems and points should be considered for monitoring and controlling by the building automation system. The selected points should be controlled and monitored at a central location, as well as from remote workstations or computers.

Systems and Points to be included in the BAS

(1) Air Handling Units
- a. Damper and valve actuators - control and position
- b. air and fluid temperatures
- c. motor status
- d. motor start-stop
- e. filter pressure drops
- f. humidifier control and humidistat alarm conditions relative to specific sequence of operation or application flow rate
- g. static pressure status
- h. flow rates

(2) Terminal Equipment
- a. space thermostats
- b. reheat coil controls
- c. duct coils
- d. VAV boxes

e. alarm conditions relative to specific sequence of operation or application

(3) Perimeter Baseboard Zones
a. valve control
b. pump start-stop
c. pump status
d. zone and fluid temperature sensors
e. alarm conditions relative to specific sequence of operation or application

(4) Fire Alarm and Fire Suppression (components addressable - each with unique address)
a. status of all central fire alarm panels
b. water flow and pressure switches
c. temperature sensors
d. smoke detectors
e. smoke and fire dampers
f. pull stations
g. horns
h. lights
i. valve supervisory switches
j. magnetic door holder at fire and smoke doors
k. alarm conditions relative to specific sequence of operation or application

(5) Security
a. status of central panel
b. status of each addressable security sensor or relay
c. alarm conditions relative to specific sequence of operation or application

(6) Vertical Transport
a. status of all elevator control panels
b. status of all elevator pit sump pumps
c. sump moisture detector
d. alarm conditions relative to specific sequence of operation or application

(7) Medical Gases
a. central oxygen manifold cylinder bank in use status (primary/reserve)
b. central oxygen pressure
c. central oxygen general unit alarm to annunciate any alarm monitored by local equipment panel
d. central nitrous oxide manifold cylinder bank in use status (primary/reserve)
e. central nitrous oxide pressure
f. central nitrous oxide general alarm to annunicate any alarm monitored by local equipment panel
g. for each medical gas zone panel;
   oxygen pressure
   nitrous oxide pressure
   medical air pressure
   medical vacuum pressure

dental air pressure
general zone alarm to annunciate any alarm monitored by local equipment
general unit alarm to annunciate any alarm monitored by local equipment

h. status of medical air compressor
i. status of medical vacuum pump
j. dental vacuum pump suction pressure

(8) Laboratory Flow Hoods
a. fan status
b. fan start/stop
c. air flow switch
d. air volume control based on sash opening height

(9) General Exhaust Fans
a. fan status
b. fan start/stop
c. air flow

(10) Boiler Plant Equipment (boiler typically controlled by boiler manufacturer provided packaged control system - BAS monitors only)
a. boiler status
b. boiler start/stop
c. boiler general alarm
d. supply header pressure or temperature
e. supply header set point
f. return header pressure or temperature
g. flowmeters for steam
h. glycol make-up pump status
i. hydronic circulating pump
    status
    start-stop
    pump failure alarm
    lead/lag control
j. alarm conditions relative to specific sequence of operation or application
k. stack temperature
l. fuel consumption

(11) Chilled Water Pump
a. pump status
b. pump start/stop
c. flow rate

(12) Domestic Water Hot Water Generators
a. circulating pumps
b. temperatures
c. flow rates

(13) Water Softener
a. status
b. alarm conditions relative to specific sequence of operation or application

(14) Incinerator
a. burner status
b. secondary combustion chamber temperature
c. alarm conditions relative to specific sequence of operation or application

(15) Chillers (controlled by manufacturer's self contained, packaged control system, interlock unit control panels with BAS. Allow override of unit controls by BAS)
a. chiller status
b. chiller start/stop
c. lead/lag chiller selection
d. chilled water return temperature - each circuit
e. chilled water supply temperature - each circuit
f. master chilled water supply setpoint
g. general unit alarm to annunciate any alarm monitored by local unit controls
h. chilled water flow rate through chiller
i. evaporator refrigerant pressure and temperature
j. condenser refrigerant pressure and liquid temperature
k. compressor refrigerant discharge temperature
l. compressor refrigerant suction temperature
m. pressure at chilled water inlet and outlet
o. pressure of condenser water at inlet and outlet
p. alarm conditions relative to specific sequence of operation or application
q. condenser water flow rate

(16) Dietary Walk-in Freezers
a. compressor status
b. freezer space temperature

(17) Blood Banks
a. blood bank temperature

(18) Fuel Supply Systems
a. storage tank fluid level
b. leak detectors
c. transfer pump status
d. general leak detection alarm panel

(19) Essential Electrical Systems
a. generator status
b. generator oil pressure
c. generator cooling fluid temperature
d. transfer switch status
e. voltage for each phase
f. amperage for each phase
g. total run-time
h. general alarm from unit's control panel
I. frequency
j. total load (KW, KVA) at system bus

(20) Electrical Service Metering
a. provide energy use (KW, KVA and power factor)

(21) Natural or Liquefied Gas
   a. provide energy usage

(22) Nurse Call System
   a. power status
   b. trouble alarm

(23) Lighting
   a. general and/or specific areas

(24) Specific Relative Pressure/Temperature Alarms
   a. operating rooms
   b. nursery
   c. ICU
   d. computer room
   e. isolation rooms
   f. laboratory

F. REFERENCE - Related information on building automation systems can be found in the latest edition of the American Institute of Architects Guidelines for Construction and Equipment of Hospital and Medical Facilities.